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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/750,054	12/30/2003	Steven Keating	42P16676	9101

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EXAMINER

DANG, TRUNG Q

ART UNIT PAPER NUMBER

2823

DATE MAILED: 03/23/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<p align="center">Office Action Summary</p>	<p>Application No.</p> <p align="center">10/750,054</p>	<p>Applicant(s)</p> <p align="center">KEATING ET AL.</p>	
	<p>Examiner</p> <p align="center">Trung Dang</p>	<p>Art Unit</p> <p align="center">2823</p>	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 16-19 and 28-30 is/are allowed.
- 6) ☒ Claim(s) 1-15 and 20-27 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>12/30/03</u> | 6) <input checked="" type="checkbox"/> Other: <u>reasons for allowance</u> |

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 1-3, 10-15, and 20-22 are rejected under 35 U.S.C. 102(e) as being anticipated by Gonzalez et al. (US. 6,784,076).

With reference to Figs. 1-5, the prior art anticipates the claims in that it discloses a process comprising the steps of:

etching a recess 18 into a substrate **10**, the recess having a bottom **26** (Fig.4);

implanting an ionized species into the bottom of the recess to form an amorphous etch stop region **30**, the ionized species being electrically neutral within the substrate (col. 5, lines 1-21); and etching the substrate with an anisotropic wet etch (Fig. 5).

Note that the wet etch process using TMAH or KOH solution that forms cavity **34** in Fig. 5 reads on the claimed anisotropic wet etch because the aforementioned wet etch using both isotropic and anisotropic etch (col. 5, lines 36-41). Furthermore, the implanted species of silicon or germanium (col.5, lines 13-14) is electrically neutral within the substrate.

As for claims 20-22, since the implantation causes the implantation region **30** to become amorphous, the crystal lattice of the substrate is inherently disrupted by the implanted species.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gonzalez et al. as above in view of Wu et al. (US 6,461,967).

Gonzalez teaches a method as described above except for the implanted species is of a noble element having characteristics as claimed.

Wu teaches that implanting electrically neutral species such as silicon ions or inert ions, for example, argon into a semiconductor substrate causes the implanted regions to become more resistant to a wet etch using a basic solution of TMAH, KOH, or NaOH. That is, the unimplanted region is etched at a faster rate than the implanted region (Figs. 2, 6; col. 39, lines 1-25; col. 40, lines 19-21, line 52; col. 41, lines 39-45).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Gonzalez's teaching by implanting the bottom of trench 18 in Fig. 4 with inert ions such as argon because the substitution of art-recognized equivalents for the same purpose would have within the level of one skilled in the art. Note that the implanting inert ions (noble elements) would inherently have characteristics as recited in claims 4 and 5.

4. Claims 7, 9, 23-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gonzalez et al. as above in view of Kinugawa (US 4,857,986).

Gonzalez teaches a method as described above. Gonzalez differs from the claims in not disclosing the crystallography as claimed.

Kinugawa teaches that the performance of a semiconductor device can be improved by fabricating the device on a semiconductor substrate having (110) surface plane as compared to that of fabricated on a

conventional semiconductor substrate having (100) surface plane (col. 2, lines 1-27).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Gonzalez's teaching by selecting the monocrystalline silicon substrate **10** having (110) surface plane as suggested by Kinugawa because of the advantage mentioned above. Note that when the silicon substrate **10** having (110) surface plane (horizontal crystal plane), the substrate would have equivalent vertical planes (001), (100), (010) (all the equivalent vertical planes are denoted by notation [100]). Furthermore, absent evident to the contrary, when the silicon substrate **10** having (110) surface plane are etched by the wet etch described in Gonzalez, the wet etch would inherently faceting along the [111] crystal plane (e.g., the planes of the diagonal edges 38, 40 in Fig. 5).

As for the structure claims 23-27, the combined process would produces the structure as claimed including the amorphous etch stop region and as well as crystal planes mentioned above.

5. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gonzalez taken with Kinugawa as applied to claims 7-9, 23-27 above, and further in view of Wu cited above.

The combined process of Gonzalez and Kinugawa teaches a process as described above. The combined process differs from the claim in not disclosing the pH of the etching basic solution.

Wu teaches an etch selectivity of a silicon-implanted region and an

unimplanted region using a basic solution of TMAH, KOH, or NaOH. The solution has a pH not less than 9 (col. 39, lines 7-80), which causes the unimplanted region being etched at a faster rate than the implanted region.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the combined teaching by making the TMAH, KOH, or NaOH solution having a pH approximately 10 or higher as claimed because such pH, in light of Wu's suggestion, would ensure high etch selectivity between etch stop layer 30 and substrate 10, i.e., the etch stop layer 30 is not etched while the substrate 10 is etched at a fast rate.

Allowable Subject Matter

6. Claims 16-19 and 28-30 are allowed over prior art of record.
7. The following is an examiner's statement of reasons for allowance:
Claim 16 and its dependent claims are allowed over prior art of record because the prior art does not teach or suggest the claimed method, which includes the formation of a gate and sidewall spacers above a single-crystal silicon substrate having crystal planes as recited in the claim. The claimed method further includes etching a recess, implanting silicon to form an amorphous etch stop, anisotropically wet etching the recess along the diagonal [111] crystal plane with an etchant having the

pH as claimed, and filling the recess with a doped semiconductor material to form source/drain region.

The device claim 28 and its dependent claims are allowed over prior art of record because the prior art does not teach or suggest the claimed transistor comprises a crystalline semiconductor substrate, a gate electrode, a pair of sidewall spacers, a pair of source/drain regions, wherein the substrate and source/drain regions having characteristics as recited in the claim.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Trung Dang whose telephone number is 571-272-1857. The examiner can normally be reached on Mon-Friday 9:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private

PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Trung Dang

Primary Examiner

Art Unit 2823

3/19/05